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한국인 2형 당뇨병에서 팀기반 교육이 혈당 조절에 미치는 효과

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The Effectiveness of Multidisciplinary Team-Based Education in the Management of Type 2 Diabetes

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Abstract

Background: Although clinicians, nurse specialists, pharmacists, and nutritionists expend significant time and resources in optimizing care for patients with diabetes, the effectiveness of integrated diabetes care team approach remains unclear. We assessed the effects of a multidisciplinary team care educational intervention on glycated hemoglobin (HbA1c) levels among diabetes patients.

Methods: We conducted a matched case-control study in Korean patients with type 2 diabetes, comparing the propensity scores pertaining to the effectiveness in reducing HbA1c levels between a group receiving

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an educational intervention and a control group. We included 40 pairs of patients hospitalized between June 2014 and September 2016. HbA1c values measured at baseline, 3 months, and 6 months were compared between the two groups.
Results: The educated group showed an improvement in HbA1c levels compared to the control group at 3 months (6.3 ± 2.3% vs. 9.5 ± 4.0%; P = 0.020) and at 6 months (7.5 ± 1.5% vs. 9.6 ± 3.0%; P = 0.106). There was a significant difference in the change in mean HbA1c from baseline to 3 months between the two groups (–35.7 ± 26.1% vs. –9.1 ± 20.5%; P = 0.013).
Conclusion: A multidisciplinary team care education intervention was advantageous for improving glucose control in patients with type 2 diabetes, and may help to optimize glycemic control in clinical practice.

Keywords: Diabetes mellitus, Glycated hemoglobin, Health education

INTRODUCTION

The prevalence of diabetes is increasing worldwide. The number of people with diabetes reached 422 million in 2014, and diabetes caused 1.5 million deaths in 2012 [1]. Despite tremendous advances in treatment over the last few decades, reducing mortality and morbidity in diabetic patients through adequate blood glucose control remains challenging.

Diabetes is a chronic disease that requires numerous daily self-care-related decisions and behaviors pertaining to food choices, physical activity, and medication use. Diabetes education improves knowledge and skills related to the control of diabetes, which is essential for people with the disease [2]. Diabetes education has been considered an important facet of the clinical management of individuals with diabetes since the 1930s [3]. The American Diabetes Association recommends assessments of diabetes self-management skills and knowledge, and the provision of diabetes education at the time of diagnosis on an, annual basis, and whenever a complication arises or transition in care occurs [2]. Diabetes education has been reported to improve blood glycemic control and reduce diabetic complications [4-7]. In addition, diabetes education reduces the hospitalization and re-admission rate of diabetic patients, thereby reducing the economic burden of treatment [8,9].

In most diabetes educational interventions, diverse educators, such as clinicians, nurses, pharmacists, nutritionists, exercise therapists, and social workers address diabetic patients individually, according to their own specific areas of expertise. Because the conditions of diabetic patients are so diverse, a uniform educational approach based on a single discipline has limitations. Each educator may emphasize the importance of his or her field without knowing what problems the patient has that are relevant to other fields, and patients could be confused due to a lack of understanding of the multilevel problems that they may encounter. In addition, there are invisible barriers in communication among diabetes educators. Therefore, diabetes education is expected to be more effective when integrated education is provided, rather than an

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individualistic approach.

In this study, we evaluated the effect of a multidisciplinary diabetes educational intervention, provided by a team of clinicians, nurse specialists, pharmacists, and nutritionists, on glycated hemoglobin (HbA1c) levels among diabetes patients.

MATERIALS AND METHODS

1. Patients, materials, and methods

In this matched case-control study, 141 patients hospitalized with type 2 diabetes were recruited at the Department of Endocrinology and Metabolism, Pusan National University Hospital. The protocols and consent procedures were approved by the Institutional Review Board of Pusan National University Hospital (approval no. 20140223).

We enrolled 40 patients in the education group who were hospitalized between June 2014 and September 2016, diagnosed with type 2 diabetes, aged above 18 years, able to communicate normally, and who agreed to take part in multidisciplinary team care sessions. Patients with cancer or severe illnesses, and those with communication problems, were excluded from the study. The control group consisted of 101 patients who were admitted during the same period and met the same exclusionary criteria as the education group, but did not receive education from the multidisciplinary team. Both education and control groups were admitted for blood glucose control. All of the education group patients had never received a team-based education before agreeing to this study. There was a significant difference in HbA1c level between the education and control groups; therefore, 27 pairs of hospitalized patients were matched using propensity scores. Propensity score matching analysis was performed with support from Department of Biostatistics of Pusan National University Hospital.

The multidisciplinary team consisted of clinicians, nurse specialists, pharmacists, and nutritionists. When a hospitalized patient meeting the inclusion and exclusion criteria, the clinician requested the multidisciplinary team care sessions after obtaining the patient's consent. The multidisciplinary team care sessions were performed once a week, and more than once during the hospital stay. Before the multidisciplinary team care sessions, the clinician, nurse specialist, pharmacist, and nutritionist individually assessed and interviewed the patient. The nurse specialist educated patients on how to properly administer insulin, and patient performance with respect to insulin injections was measured by the Performance Accuracy Questionnaire for Insulin Injection (Supplementary Table 1). The pharmacist educated patients about oral hypoglycemic agents, and medication compliance was measured by the Modified Morisky Scale (Supplementary Table 2). The nutritionist educated patients about the diabetic diet. The nutrition assessment, diagnosis, and intervention were evaluated according to nutritional counseling results (Supplementary Table 3). On the day of the multidisciplinary team care session, all team members convened just before the session to present and discuss the patient's condition. The clinician led the multidisciplinary team care sessions, which were held during the patient's lunch time. After each round of multidisciplinary team care, the team members discussed the patient and wrote a report.

All patient charts were reviewed by the same

clinician. HbA1c levels were measured at the time of enrollment, and at 3 and 6 months post-enrollment. HbA1c levels measured at 3 and 6 months included data collected 1 month before and after.

2. Statistical analyses

Statistical analyses were performed using SAS software (ver. 9.3.0; SAS Institute, Cary, NC, USA) and R software (ver. 3.3.2; R Development Core Team, Vienna, Austria). Data are presented as mean ± standard deviation or as median (interquartile range) for skewed variables. Differences between the two groups were analyzed by parametric two-sample t-tests and non-parametric Wilcoxon rank-sum tests. The chi-squared test was applied to analyze categorical variables. The nearest neighbor matching method was used to classify the education group based on the similarity to the control group propensity score. A two-tailed $P < 0.05$ was considered statistically significant.

RESULTS

1. Baseline patient characteristics

Table 1 summarizes the baseline characteristics of

Table 1. Baseline characteristics of the patients with type 2 diabetes

	Unmatched			Matched		
	Control group (n = 101)	Education group (n = 40)	*P*-value	Control group (n = 27)	Education group (n = 27)	*P*-value
Sex, male (%)	42 (41.6)	19 (47.5)	0.652	12 (44.4)	12 (44.4)	0.999
Age (y)	62.8 ± 14.0	59.5 ± 15.2	0.241	62.5 ± 13.1	61.9 ± 16.8	0.879
Body weight (kg)	63.2 (55.8~70.0)	61.4 (51.3~71.6)	0.558	62.9 (57.0~66.8)	62.5 (54.4~72.5)	0.762
BMI (kg/m^2)	24.8 ± 4.9	24.0 ± 4.7	0.335	24.5 ± 5.3	24.9 ± 4.2	0.741
Duration of diabetes (y)	13.1 ± 10.3	14.7 ± 10.0	0.404	15.4 ± 12.5	14.7 ± 10.8	0.807
SBP (mm Hg)	130 ± 16	129 ± 20	0.687	129 ± 19	129 ± 20	0.999
DBP (mm Hg)	77 ± 10	76 ± 12	0.663	77 ± 11	76 ± 12	0.678
HbA1c (%)	9.2 ± 2.5	10.9 ± 2.1	< 0.001	10.0 ± 3.1	10.2 ± 2.0	0.778
LDL cholesterol (mg/dL)	96 ± 39	114 ± 47	0.154	84 ± 30	104 ± 34	0.102
HDL cholesterol (mg/dL)	46 (38~54)	48 (38~62)	0.771	41 (36~49)	48 (37~63)	0.382
Triglycerides (mg/dL)	124 (91~211)	147 (93~270)	0.672	123 (76~200)	147 (88~270)	0.678

Values are presented as number (%), mean ± standard deviation, or median (interquartile range) for continuous variables and frequencies (percentage) for categorical variables.
BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HbA1c, glycated hemoglobin; LDL, low-density lipoprotein; HDL, high-density lipoprotein.

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the patients with type 2 diabetes. Sex, age, body mass index, duration of diabetes, systolic blood pressure, diastolic blood pressure, and lipid profiles did not significantly differ between the education group and the control group. HbA1c levels were higher in the education group than in the control group in an unmatched case-control study. Table 2 shows differences in the status of baseline medication between the two groups. There were no patients treated with oral antidiabetic drugs in the education group, and a basal-bolus insulin regimen was more common in the education group than in the control group.

2. Changes in HbA1c level: comparison between the education group and the control group

In the education group, the HbA1c level was significantly reduced, from 10.2 ± 2.0% to 6.3 ± 2.3%, after 3 months of multidisciplinary team-based diabetes education (Fig. 1A). In the control group, the HbA1c

Table 2. Status of baseline medication

	Matched		
	Control group (n = 27)	Education group (n = 27)	*P*-value
Antidiabetic agents			
OADs	6 (22.2)	0	0.023[a]
Basal insulin + OADs	9 (33.3)	8 (29.6)	0.770[b]
Basal-bolus insulin	12 (44.4)	19 (70.4)	0.054[b]
Antihypertensive agents	17 (63.0)	21 (77.8)	0.233[b]
Dyslipidemic agents	21 (77.8)	15 (55.6)	0.083[b]

Values are presented as number (%).
OADs, oral antidiabetic drugs.
[a]Fisher's exact test. [b]Chi-square test.

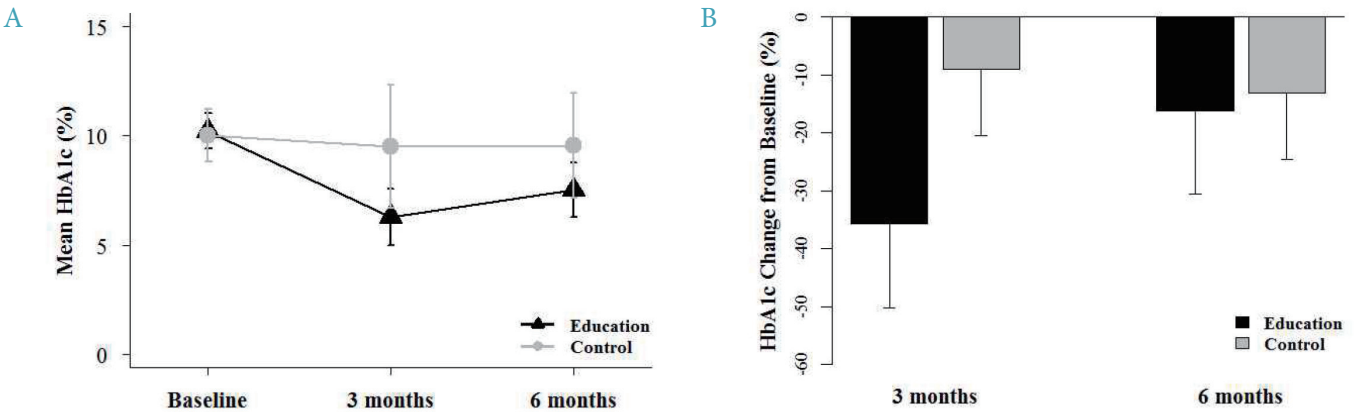

Fig. 1. (A) Changes in glycated hemoglobin (HbA1c) from baseline at 3 and 6 months. (B) Time-course of mean HbA1c between education group and control group in patients with type 2 diabetes. Values are presented as mean ± 95% confidence interval.

Table 3. Changes in HbA1c between education group and control group in patients with type 2 diabetes

	Control group		Education group		*P*-value[a]	*P*-value[b]
	n	Mean ± SD	n	Mean ± SD		
HbA1c (%)						
Baseline	27	10.0 ± 3.1	27	10.2 ± 2.0	0.778	0.489
3 months	10	9.5 ± 4.0	14	6.3 ± 2.3	0.020	0.035
6 months	8	9.6 ± 3.0	8	7.5 ± 1.5	0.106	0.052
Change from baseline (%)						
3 months	10	−9.1 ± 20.5	14	−35.7 ± 26.1	0.013	0.021
6 months	8	−13.2 ± 14.1	8	−16.2 ± 13.6	0.668	0.793

HbA1c, glycated hemoglobin.
[a]Two sample t-test. [b]Wilcoxon rank-sum test.

level was reduced from 10.0 ± 3.1% to 9.5 ± 4.0% after 3 months. After 3 months, the reduction rate was −35.7 ± 26.1% in the education group and −9.1 ± 20.5% in the control group (Fig. 1B), and there was a significant difference between the two groups (P = 0.013; Table 3).

The HbA1c level in the education group after 6 months was 7.5 ± 1.5%, which was slightly higher than that after 3 months. The HbA1c level after 6 months in the control group was 9.6 ± 3.0%. The HbA1c level of the education group tended to be lower than that of the control group after 6 months, but the difference in HbA1c level between the two groups after 6 months was not significant (P = 0.106).

DISCUSSION

In this study, patients who received team-based diabetes education had lower HbA1c levels at the 3-month follow-up than the non-educated control group patients. This suggests that a multidisciplinary educational intervention provided by clinicians, nurse specialists, pharmacists, and nutritionists can increase the effectiveness of treatment for diabetic patients.

Previous studies have shown that various forms of diabetes education are associated with lower HbA1c levels in diabetes patients. Steinsbekk et al. [10] reported that group-based diabetic self-management education in adult type 2 diabetes patients reduced the HbA1c level by 0.87% and improved diabetic knowledge and self-management skills. Norris et al. [5] reported that self-management education lowered the HbA1c level by 0.76%. According to a study by Kim et al. [6] done in Korea, the HbA1c level decreased from 7.84% to 6.79% following self-management education. Several previous studies have also reported a reduction in HbA1c of about 1% after diabetes education [11-14]. In this study, 3 months after team-based diabetes education, the HbA1c level decreased from 10.2 ± 2.0% to 6.3 ± 2.3%, a considerable change compared to previous studies. However, this may be due to the effects of increased diabetic medication use.

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According to the UK Prospective Diabetes Study (UKPDS), a 1% reduction in the HbA1c level over 10 years reduces the risk of diabetes-related death by 21%, reduces myocardial infarction risk by 14%, and reduces the microvascular complication rate by 36% [15]. Therefore, the decrease in HbA1c level from 10.2 ± 2.0% to 6.3 ± 2.3% after 3 months in this study was very meaningful. However, there was no significant difference in HbA1c between the education group and the control group after 6 months. Norris et al. [5] reported that the initial effects of diabetes education decreased after 6 months. Brown reported that the effects peaked 1 to 6 months after intervention, and decreased to back to the initial level after 6 months [16]. The effects of education decreased with longer follow-up intervals after the intervention in the study by Norris et al. [5]. This trend is common not only among studies of diabetes education, but also in studies of other behavioral interventions for weight loss [17-19]. Although diabetes education is effective, the data suggest that the benefit does not persist. For diabetes education to effectively reduce long-term complications, the initial effects of glycemic control must be maintained over the long-term. Therefore, regular and continuous long-term intervention is required.

The limitations of this study were as follows. First, drug treatments were not taken into consideration, although medication changes can affect treatment effectiveness. Second, the patient enrollment rate was low, and follow-up loss was high. Third, we did not investigate changes such as complications other than HbA1c. Fourth, there was no assessment of changes in the method of drug administration, the method of insulin injection, compliance with medication, dietary control, etc. Despite these limitations, this study is meaningful as the first study to paradoxically emphasize the importance of team-based education in the management of type 2 diabetes when considering the clinical situation in Korea where it is not easy for diabetes education to satisfy both patients and medical staff within a limited time.

In this study, the positive effect on glycemic control seen after the team-based diabetes education intervention was presumably due to appropriate administration methods, and improvements in compliance with medications, dietary habits, and insulin use. Multidisciplinary education delivered by clinicians, nurse specialists, pharmacists, and nutritionists can lead to proper glycemic control and, ultimately, a reduction in diabetes complications and mortality. Continuous follow-up and education on the various factors influencing glycemic control are required for sustained effectiveness. However, it is difficult to provide a team-based diabetes education intervention to all diabetes patients. In practice, patients often receive medication in small primary clinics as well as in large hospitals, and it is rare to encounter diabetes experts other than doctors at these primary clinics. Previous studies reported variously that only 26.2% and 39.4% of diabetes patients received diabetes education [20,21]. The effectiveness of diabetes education has already been shown in multiple studies; thus, it is necessary to find ways to overcome the limitations associated with practical application of diabetes education.

In conclusion, this study showed that team-based diabetes education, involving clinicians, nurse specialists, pharmacists, and nutritionists, improved glycemic control in diabetes patients. Further research is needed to determine whether the long-term effects of team-based diabetes education lead to long-term

maintenance of target HbA1c levels and thus reduce the rate of diabetic complications.

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. World Health Organization: Global report on diabetes. Available from: www.who.int/diabetes/global-report (updated 2016).
2. Powers MA, Bardsley J, Cypress M, Duker P, Funnell MM, Hess Fischl A, Maryniuk MD, Siminerio L, Vivian E. Diabetes self-management education and support in type 2 diabetes: a joint position statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. Diabetes Care 2015;38:1372-82.
3. Bartlett EE. Historical glimpses of patient education in the United States. Patient Educ Couns 1986;8:135-49.
4. Gagliardino JJ, Aschner P, Baik SH, Chan J, Chantelot JM, Ilkova H, Ramachandran A; IDMPS investigators. Patients' education, and its impact on care outcomes, resource consumption and working conditions: data from the International Diabetes Management Practices Study (IDMPS). Diabetes Metab 2012;38:128-34.
5. Norris SL, Lau J, Smith SJ, Schmid CH, Engelgau MM. Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. Diabetes Care 2002;25:1159-71.
6. Kim MY, Suh S, Jin SM, Kim SW, Bae JC, Hur KY, Kim SH, Rha MY, Cho YY, Lee MS, Lee MK, Kim KW, Kim JH. Education as prescription for patients with type 2 diabetes mellitus: compliance and efficacy in clinical practice. Diabetes Metab J 2012;36:452-9.
7. Choi MJ, Yoo SH, Kim KR, Bae YM, Ahn SH, Kim SS, Min SA, Choi JS, Lee SE, Moon YJ, Rhee EJ, Park CY, Lee WY, Oh KW, Park SW, Kim SW. Effect on glycemic, blood pressure, and lipid control according to education types. Diabetes Metab J 2011;35:580-6.
8. Healy SJ, Black D, Harris C, Lorenz A, Dungan KM. Inpatient diabetes education is associated with less frequent hospital readmission among patients with poor glycemic control. Diabetes Care 2013;36:2960-7.
9. Robbins JM, Thatcher GE, Webb DA, Valdmanis VG. Nutritionist visits, diabetes classes, and hospitalization rates and charges: the Urban Diabetes Study. Diabetes Care 2008;31:655-60.
10. Steinsbekk A, Rygg LØ, Lisulo M, Rise MB, Fretheim A. Group based diabetes self-management education compared to routine treatment for people with type 2 diabetes mellitus. A systematic review with meta-analysis. BMC Health Serv Res 2012;12:213.
11. Tshiananga JK, Kocher S, Weber C, Erny-Albrecht K, Berndt K, Neeser K. The effect of nurse-led diabetes self-management education on glycosylated hemoglobin and cardiovascular risk factors: a meta-analysis. Diabetes Educ 2012;38:108-23.
12. Welch G, Zagarins SE, Feinberg RG, Garb JL. Motivational interviewing delivered by diabetes educators: does it improve blood glucose control among

 https://doi.org/10.4093/jkd.2018.19.2.119

poorly controlled type 2 diabetes patients? Diabetes Res Clin Pract 2011;91:54-60.

13. Deakin T, McShane CE, Cade JE, Williams RD. Group based training for self-management strategies in people with type 2 diabetes mellitus. Cochrane Database Syst Rev 2005;(2):CD003417.
14. Gary TL, Genkinger JM, Guallar E, Peyrot M, Brancati FL. Meta-analysis of randomized educational and behavioral interventions in type 2 diabetes. Diabetes Educ 2003;29:488-501.
15. Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, Hadden D, Turner RC, Holman RR. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. BMJ 2000;321:405-12.
16. Brown SA. Meta-analysis of diabetes patient education research: variations in intervention effects across studies. Res Nurs Health 1992;15:409-19.
17. Norris SL, Engelgau MM, Narayan KM. Effectiveness of self-management training in type 2 diabetes: a systematic review of randomized controlled trials. Diabetes Care 2001;24:561-87.
18. Wing RR, Goldstein MG, Acton KJ, Birch LL, Jakicic JM, Sallis JF Jr, Smith-West D, Jeffery RW, Surwit RS. Behavioral science research in diabetes: lifestyle changes related to obesity, eating behavior, and physical activity. Diabetes Care 2001;24:117-23.
19. Wing RR. Behavioral approaches to the treatment of obesity. In: Bray GA, Bouchard C, James WPT, eds. Handbook of obesity. New York: Marcel Dekker; 1998. p855-73.
20. Park SW, Kim DJ, Min KW, Baik SH, Choi KM, Park IB, Park JH, Son HS, Ahn CW, Oh JY, Lee J, Chung CH, Kim J, Kim H. Current status of diabetes management in Korea using National Health Insurance database. J Korean Diabetes Assoc 2007;31:362-7.
21. Lee JR, Kim SA, Yoo JW, Kang YK. The present status of diabetes education and the role recognition as a diabetes educator of nurses in Korea. Diabetes Res Clin Pract 2007;77 Suppl 1:S199-204.

Supplementary Table 1.
인슐린 주사행위에 대한 수행정확도 설문지

다음은 인슐린 주사행위 시 정확도에 대해 알아보고자 하는 내용입니다. 대상자에게 평소 사용하는 인슐린(병형인슐린 또는 펜형인슐린)을 선택하게 하고 일회용 주사기, 일회용 주사바늘, 일회용 알코올솜, 손소독제를 제공하고 대상자에게 인슐린 주사행위를 시연하게 한 후 시연을 연구자가 관찰하여 채점기준에 따라 정확히 수행하는지 여부를 판단합니다. 단, 처방된 인슐린 양은 연구자가 공통적으로 20단위를 측정하게 하고 삽입행위 시 바늘의 뚜껑을 씌워 직접 피부에 바늘이 닿지 않도록 합니다.

번호	관찰내용	정확히 수행함	정확히 수행하지 않음
1	상온의 인슐린을 사용한다.		
2	펜형 인슐린의 고무마개 부분을 소독한다. (인슐린 병의 고무마개 부분을 소독한다.)		
3	무균적으로 펜형 인슐린에 바늘을 연결하거나 주사기에 인슐린을 잰다.		
4	정확한 양을 측정하기 위해 펜이나 주사기의 공기를 제거할 수 있다.		
5	처방된 용량을 정확하게 준비한다.		
6	적절한 주사 부위를 선택한다.		
7	펜형 인슐린 주사 후 주입버튼을 10초 이상 누른 후 바늘을 뺀다.		
8	주사 부위를 적절하게 순환시킨다.		
9	주사 부위를 알코올솜으로 소독한다.		
10	소독 부위는 만지지 않고 주사 부위의 조직을 집어 올린다.		
11	주사바늘을 45~90도 각도로 삽입하고 약물을 주입한다.		
12	주사바늘을 뺀 후 알코올솜으로 주사 부위를 살며시 눌러준다.		
13	인슐린 주사기 또는 주사바늘을 한 번만 사용한다.		
14	사용한 주사기와 주사바늘을 적절하게 폐기한다.		

인슐린 주사행위 정확도 채점기준표

번호	관찰내용	수행정확도	
		정확히 수행함 (1점)	정확히 수행하지 않음 (0점)
1	상온의 인슐린을 사용한다.	상온의 인슐린을 사용한다.	
2	펜형 인슐린의 고무마개 부분을 소독한다. (인슐린 병의 고무마개 부분을 소독한다.)	펜형 인슐린인 경우 고무마개 부분을 소독솜으로 닦고 바늘을 연결한다. (인슐린을 주사기로 뽑아내기 전 알코올솜으로 병형 인슐린의 고무마개 부분을 소독한다.)	펜형 인슐린의 경우 고무마개 부분을 소독하지 않고 바늘을 연결한다. (소독하지 않고 인슐린 병에 주사기를 꽂아 인슐린을 뽑아낸다.)

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3	무균적으로 펜형 인슐린에 바늘을 연결하거나 주사기에 인슐린을 잰다.	오염시키지 않고 펜과 바늘을 연결한다. (인슐린병에 주사기를 연결하여 인슐린을 뽑는 동안 바늘이 멸균된 상태로 유지된다.)	펜에 바늘을 연결되는 동안 오염된다. (주사기에 인슐린을 뽑는 동안 바늘이 다른 부위에 닿아 오염된다.)
4	정확한 양을 측정하기 위해 펜이나 주사기의 공기를 제거할 수 있다.	펜형: 주사바늘의 뚜껑을 벗기고 직각으로 세운 후 인슐린 용기를 손가락으로 톡톡 쳐서 인슐린 용기 안의 공기를 위로 모은 후 인슐린 용기를 한 번 돌린다. 주입버튼을 눌러 주사바늘 끝에 인슐린이 맺히는 것을 확인하고 처방된 양을 준비한다. 병형: 뽑을 인슐린 양만큼 주사기에 공기를 채운 후 병을 거꾸로 들어 인슐린 용액을 뽑아 내어 주사기에서 공기를 제거하고 처방된 양을 준비한다.	펜형: 주사바늘에 인슐린이 맺히는 것을 확인하지 않고 처방된 양을 준비한다. 병형: 공기 제거 없이 인슐린을 주사기에 채운다.
5	처방된 용량을 정확하게 준비한다.	펜형 인슐린의 다이얼을 20단위에 맞춘다. (주사기에 인슐린 20단위를 뽑아낸다.)	펜형 인슐린의 다이얼이 20단위가 아니다. (주사기에 뽑힌 인슐린이 20단위보다 많거나 적다.)
6	적절한 주사 부위를 선택한다. (인슐린을 어느 부위에 주사할지 묻고 선택하게 한다.)	팔의 상부외측, 대퇴부 바깥 부위, 복부(배꼽 5 cm 주위) 중에서 선택한다.	부적절한 주사 부위를 선택한다. (근육이 발달하거나 혈관이나 신경의 분포가 많은 부위에 주사한다.)
7	펜형 인슐린 주사 후 주입버튼을 10초 이상 누른 후 바늘을 뺀다.		
8	주사 부위를 적절하게 순환시킨다. (내일은 어느 부위에 주사할 것인지 묻고 선택하게 한다.)	주사한 부위에서 1~2 cm 정도 떨어진 부분을 선택한다.	오늘 주사한 부위와 동일한 부위에 주사하거나 전혀 다른 부위를 선택한다. (예: 오늘 대퇴 부위라면 내일은 복부)
9	주사 부위를 알코올솜으로 소독한다.	알코올솜으로 주사 부위를 안쪽에서 바깥쪽으로 둥글게 닦는다.	알코올솜으로 주사 부위를 소독하지 않는다.
10	소독 부위는 만지지 않고 주사 부위의 조직을 집어 올린다.	소독 부위는 만지지 않고 주사 부위를 집어올린다.	소독 부위를 만지거나 주사 부위를 집어올리지 않는다.
11	주사바늘을 45~90도 각도로 삽입한다.	조직을 집어올린 상태에서 조직의 두께에 따라 주사 바늘을 45~90도 각도로 삽입한다.	조직을 집어올리지 않고 있거나 집어올린 두께에 맞지 않는 각도로 삽입한다.
12	주사 후 알코올솜으로 주사 부위를 살며시 눌러준다.	주사 부위를 비비지 않고 알코올솜으로 살며시 누른다.	주사 부위를 알코올솜으로 비빈다.
13	인슐린 주사과정에 무균술을 지킨다.	주사과정 중 인슐린 주사기의 바늘이 소독된 부위 이외에 닿지 않는다.	주사과정 중 인슐린 주사기의 바늘이 소독된 부위 이외에 닿는다.
14	사용한 주사기와 바늘을 적절하게 폐기한다.	사용한 주사기와 주사바늘의 뚜껑을 씌우고 "버리시겠습니까?"라고 질문 시 "예"라고 답한다.	사용한 주사기와 주사바늘의 뚜껑을 씌우고 "버리시겠습니까?"라고 질문 시 "아니오"라고 답한다.

Supplementary Table 2.
복약순응도 측정(Modified Morisky Scale)

날짜:	이름:

질문	동기	지식
1. 약 먹는 것을 잊은 적이 있습니까?	예(0) 아니오(1)	
2. 약 먹는 데 무관심할 때가 있습니까?	예(0) 아니오(1)	
3. 상태가 좋다고 느끼면 약을 먹지 않을 때가 있습니까?		예(0) 아니오(1)
4. 약을 먹는데도 상태가 나빠지는 것 같으면 약을 먹지 않을 때가 있습니까?		예(0) 아니오(1)
5. 의사나 약사가 말한 대로 약을 먹을 때의 장기적 이점에 관하여 아십니까?		예(1) 아니오(0)
6. 때 맞추어 처방약을 다시 받는 것을 잊어버릴 때가 있습니까?	예(0) 아니오(1)	
총점:		

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Supplementary Table 3.
영양상담 결과지

이름:	(등록번호)	성별/나이: /	방문일:

영양판정	
환자 과거력	주진단 및 주증상 :
	병력 :
	약물처방 :
	기타 특이사항 :
신체계측	Ht: cm Wt: kg IBW: kg PIBW: % BMI: kg/m^2 Usual Wt: kg Wt change: kg(%)/기간: M TSF: mm (%ile) MAC: mm MAMC: cm(%ile) Body fat : kg(%) Waist circumference: cm
생화학적자료/ 의학적검사와 처치	Labs:(일시:)
영양관련 신체검사자료	소화기 관련 증상:
	활력 증후:
	기타 :

식품/영양소와 관련된 식사력	식사처방 및 식사관련 경험 및 환경
	식품 및 수분/음료 섭취
	에너지 및 영양소 섭취량(평소 섭취량 기준) 에너지 kcal, C:P:F ratio = : : (%) 단백질 g, 당질 g, 지방 g
	지식/신념/태도 :
	약물과 약용 식물 보충제, 생리활성물질:
	알코올 섭취 및 흡연:
	신체적 활동 및 기능:
영양필요량	에너지 kcal, (기준체중 ABW , 산출근거 ABW*30) 단백질 g, (기준체중 ABW , 산출근거 ABW*0.8)

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영 양 진 단		
문제	원인	징후/증상

영 양 중 재			
영양처방	죽당뇨신부전 1600		
영양중재	■식품/영양소 제공 ■영양교육 ■영양상담 □다분야 협의		
	영양진단	중재내용	목표/기대효과
제공교육자료			
f/u 일정			